Istituto Nazionale di Fisica Nucleare
LABORATORI NAZIONALI DI LEGNARO

Laboratori Nazionali di Legnaro – INFN

IRIS Control System and GUI – Overview

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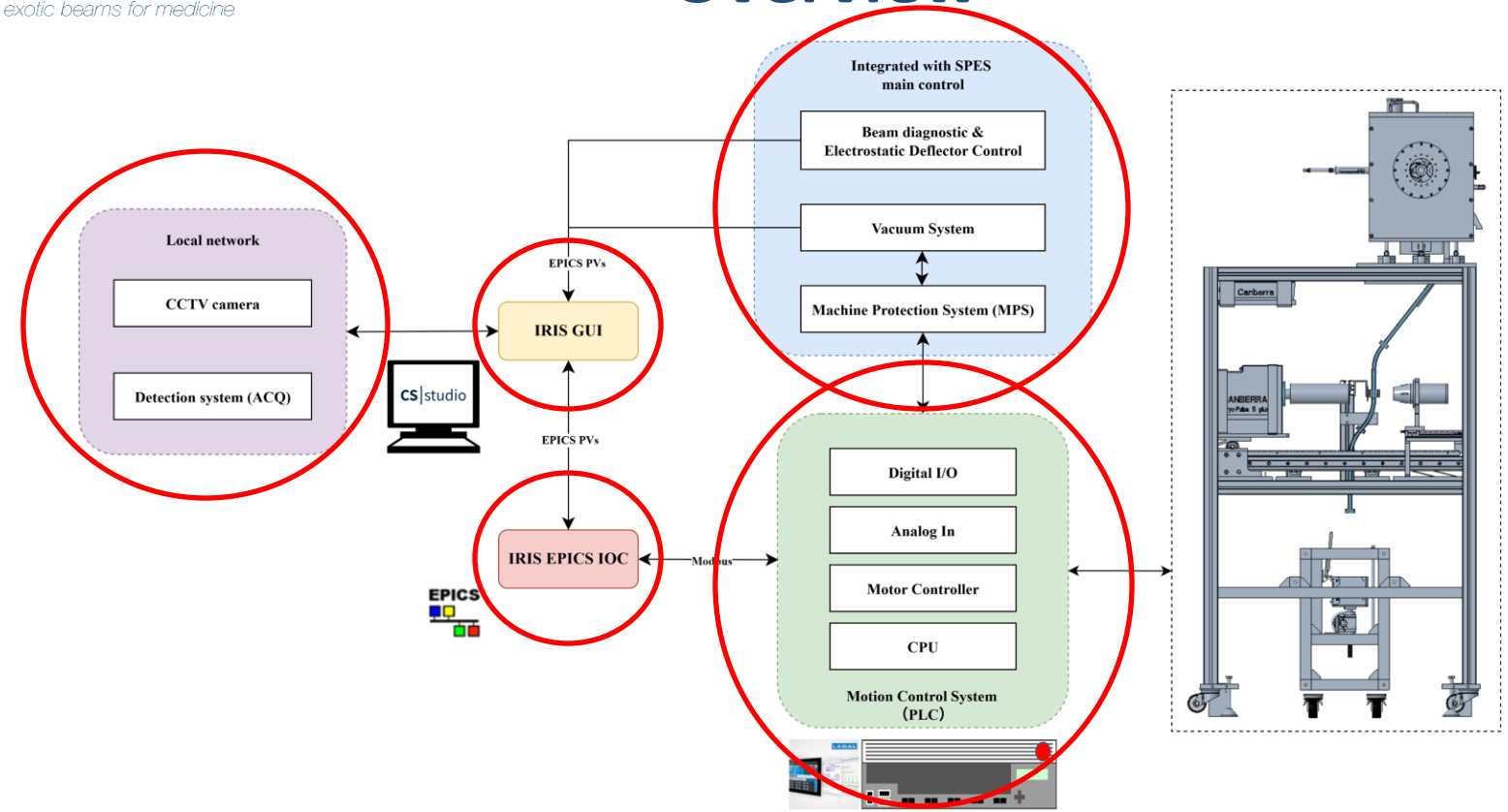
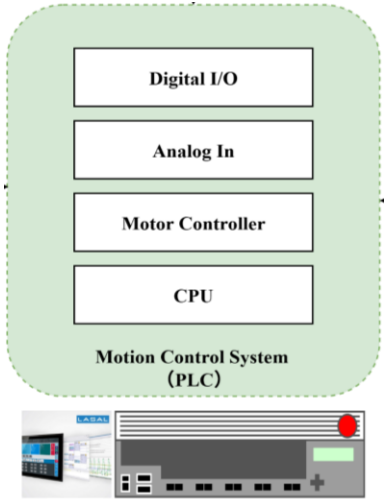
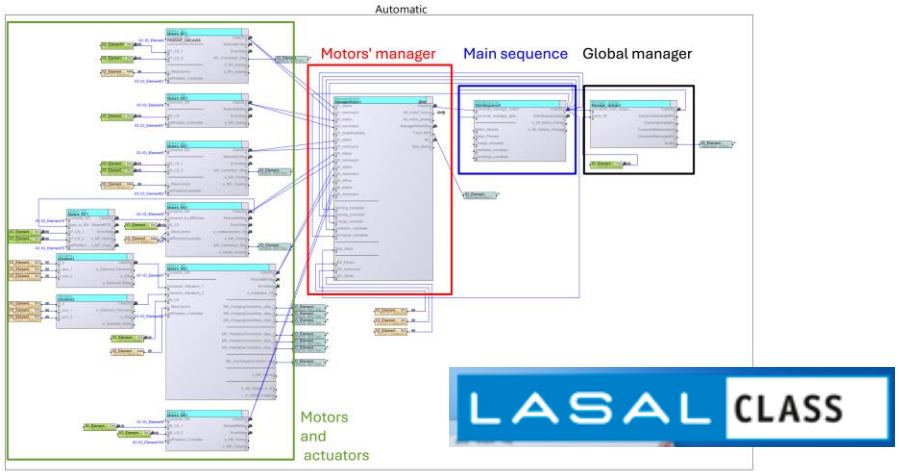
Overview


Integrated with SPES main control
Beam diagnostic & Electrostatic Deflector Control
Vacuum System
Machine Protection System (MPS)
Local network
CCTV camera
Detection system (ACQ)
EPICS PVs
IRIS GUI
CS|studio
EPICS PVs
IRIS EPICS IOC
Modbus
EPICS
Digital I/O
Analog In
Motor Controller
CPU
Motion Control System (PLC)
Canberra
ANBERRA

Motion Control System



- Sigmatek **PLC modules:** CPU, Motion controllers, Digital/Analog I/O
- **Finite State Machine (FSM)**
  - Management and segmentation of the system's various operational states and control logics.
  - System designed for easy scalability

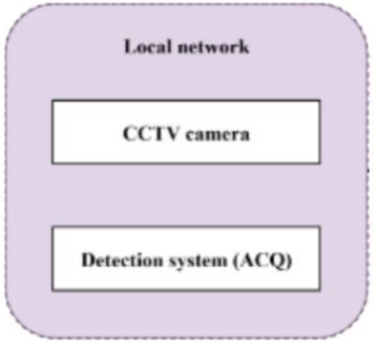


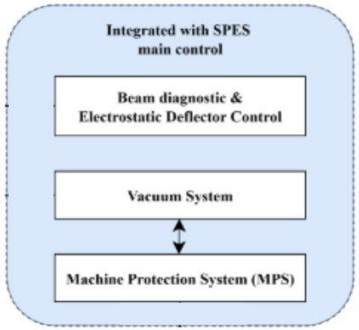
IRIS GUI & EPICS IOc

IRIS GUI:
IRIS Graphical User Interfaces (GUI) is based on **CS-Studio** a suite of tools designed for **interacting** with control systems.

EPICS IOc:
EPICS Input Output controller (IOc) it's a software based on **EPICS** and it acts as a bridge between the PLC and the GUI making possible the exchange of variables between them.

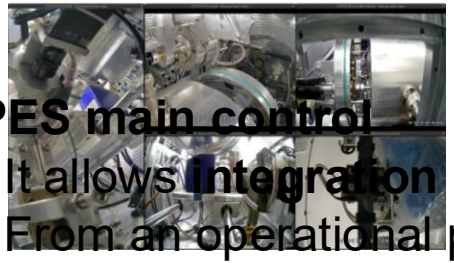
Local network & SPES main control

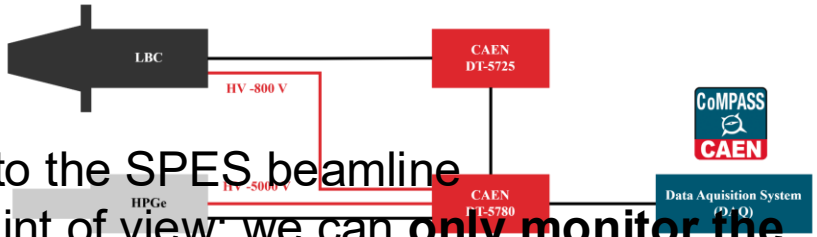




Local Network

- **CCTV cameras:** Used to monitor the process.
- **Detection system (ACQ)**: A data acquisition system based on detectors (CoMPASS).

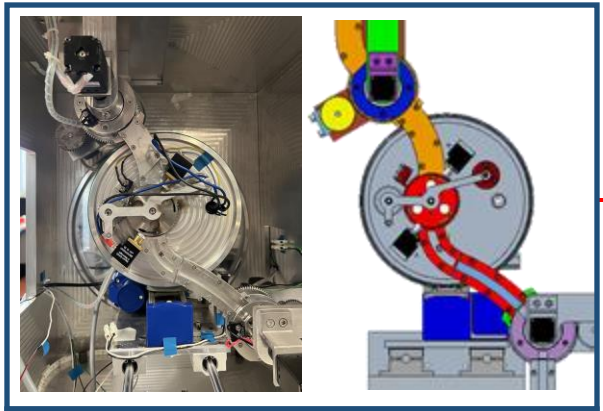




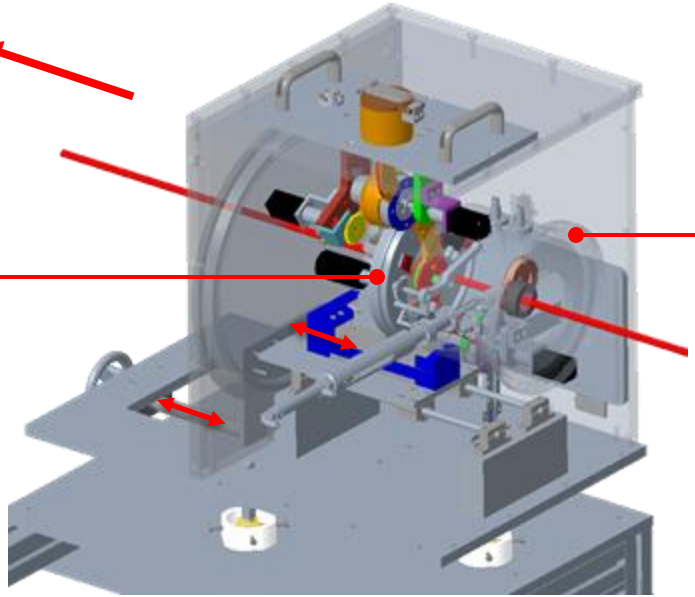
SPES main control

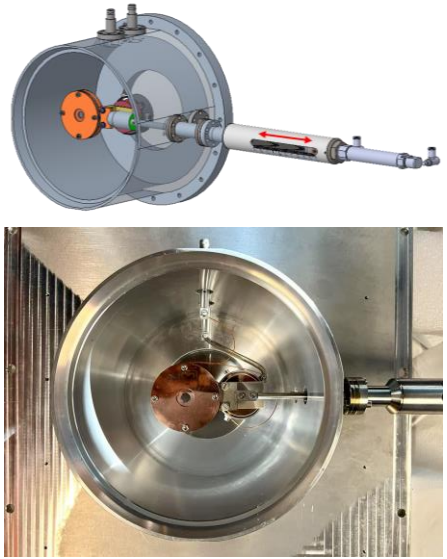
- It allows **integration** into the SPES beamline
- From an operational point of view: we can **only monitor the variables** provided by the system, without the ability to send commands or modify its behavior.

IRIS Framework – Implantation station



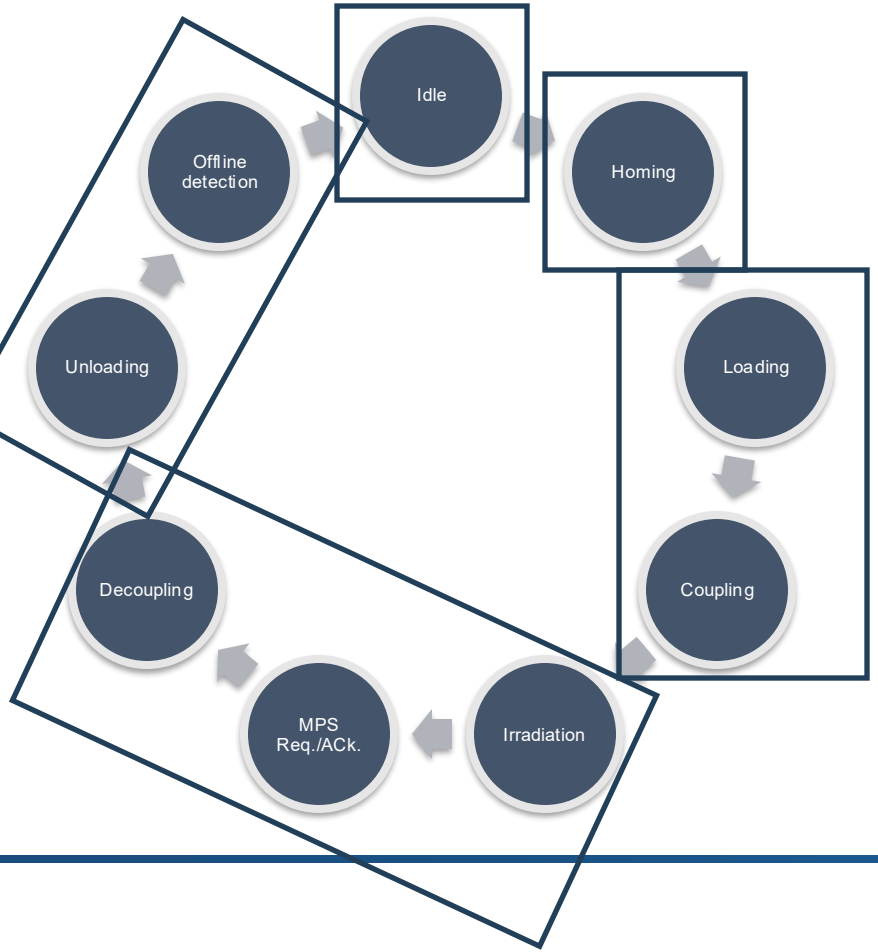
Motion system
- Loading, Alignment, Unloading





Implantation Chamber

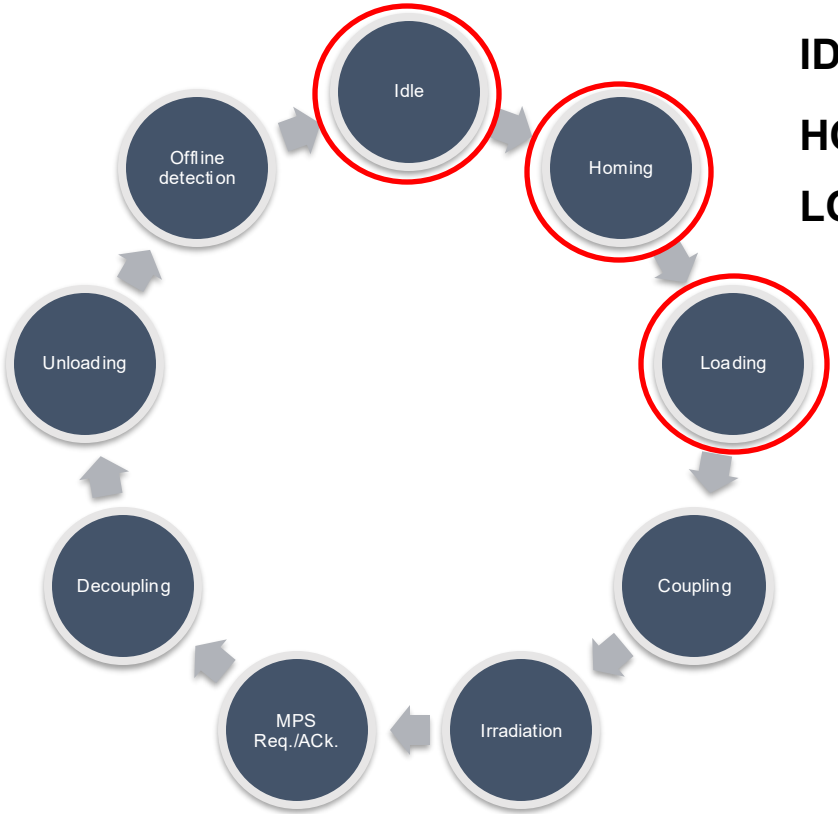
Workflow



The process is structured in 5 different phases:

- **Idle**
- **Homing**
- **Charge**:
  - Loading
  - Coupling
- **Irradiation**:
  - Irradiation
  - MPS Req./ACK
  - Decoupling
- **Discharge**:
  - Unloading
  - Offline detection

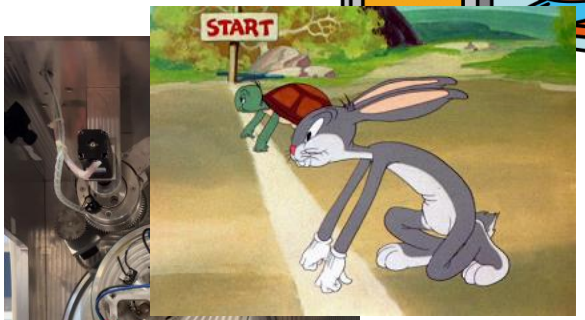
Workflow



IDLE: waiting for external command.

HOMING: All motors are set to their z

LOADING:



Workflow

MPS REQ/ACK

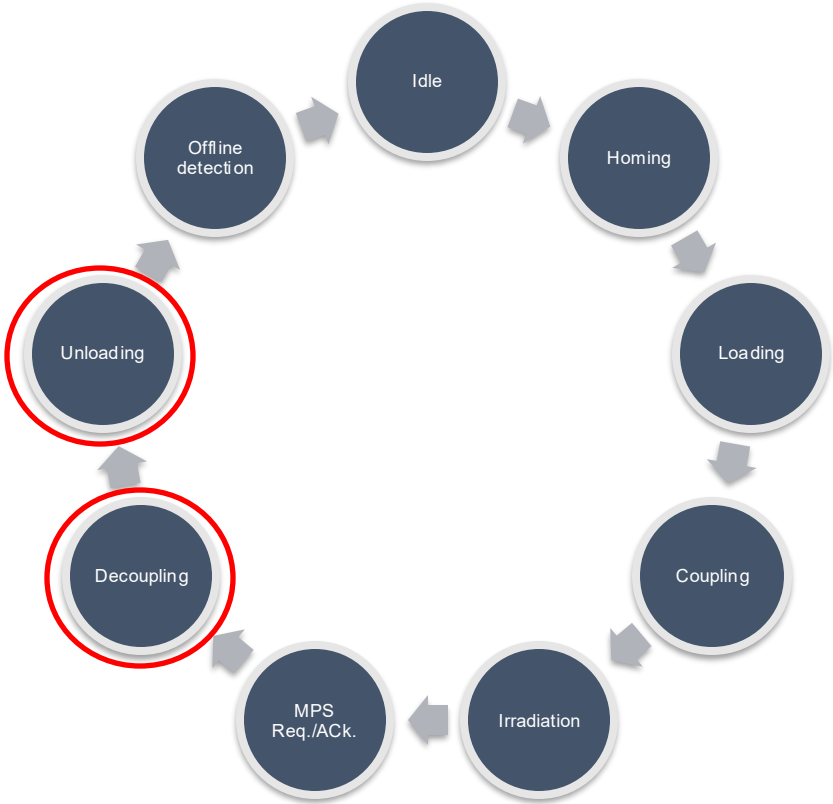
Communications with Machine Protection System for a safe decoupling

IRRADIATION

If the operational conditions are reached

Pellets are transported to the irradiation position one at a time and remain there for the required time.

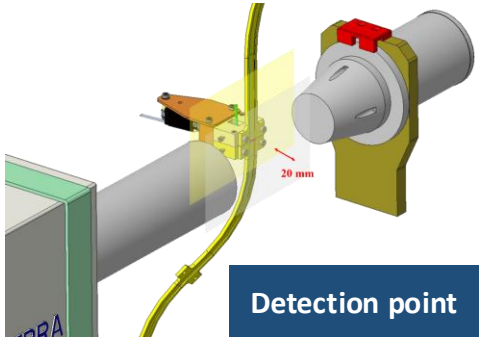
Workflow

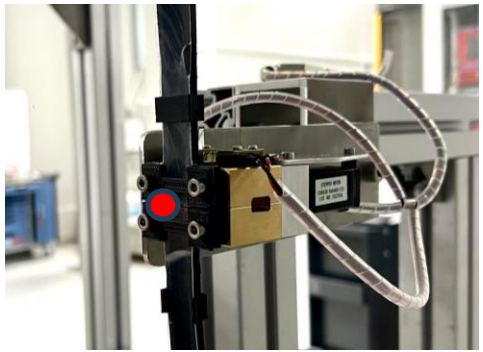


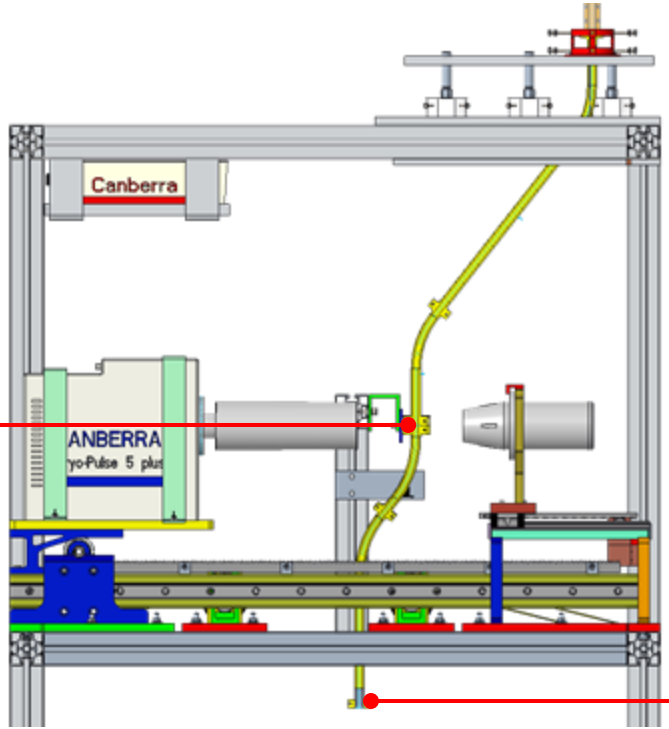
DECOUPLING

UNLOADING

IRIS framework – Offline detection system

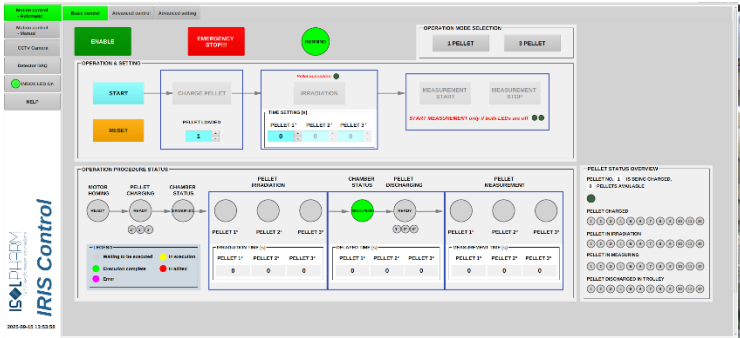






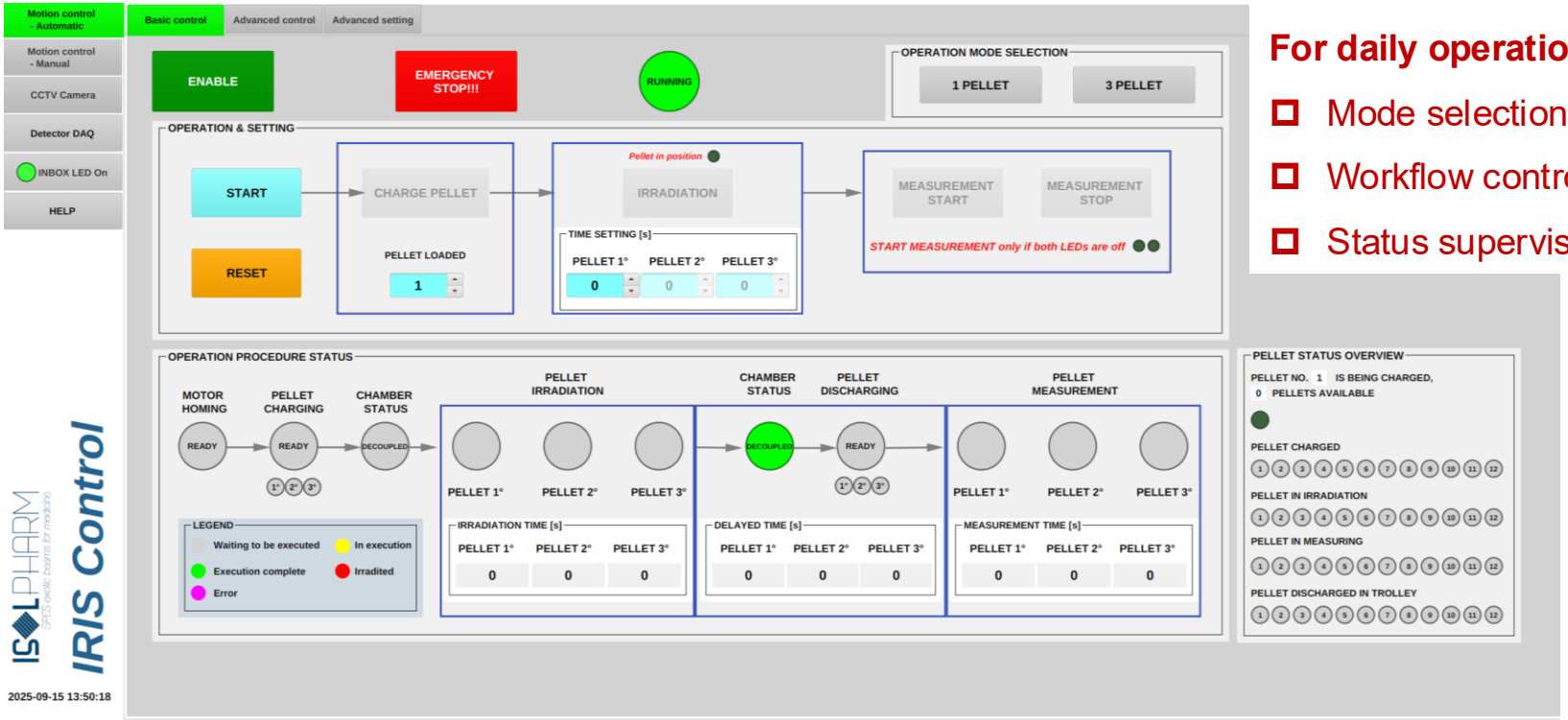
IRIS GUI

- **Multi-tab configuration -** Integrated, Intuitive, User-friendly, Constrained
- **Responsibility -** Control and Supervision
- **User-oriented GUI design**
  - Three motion control modes for various operational requirements
  - Constraints for preventing misoperation
  - Instant manual … …



Motion control - Automatic - Base

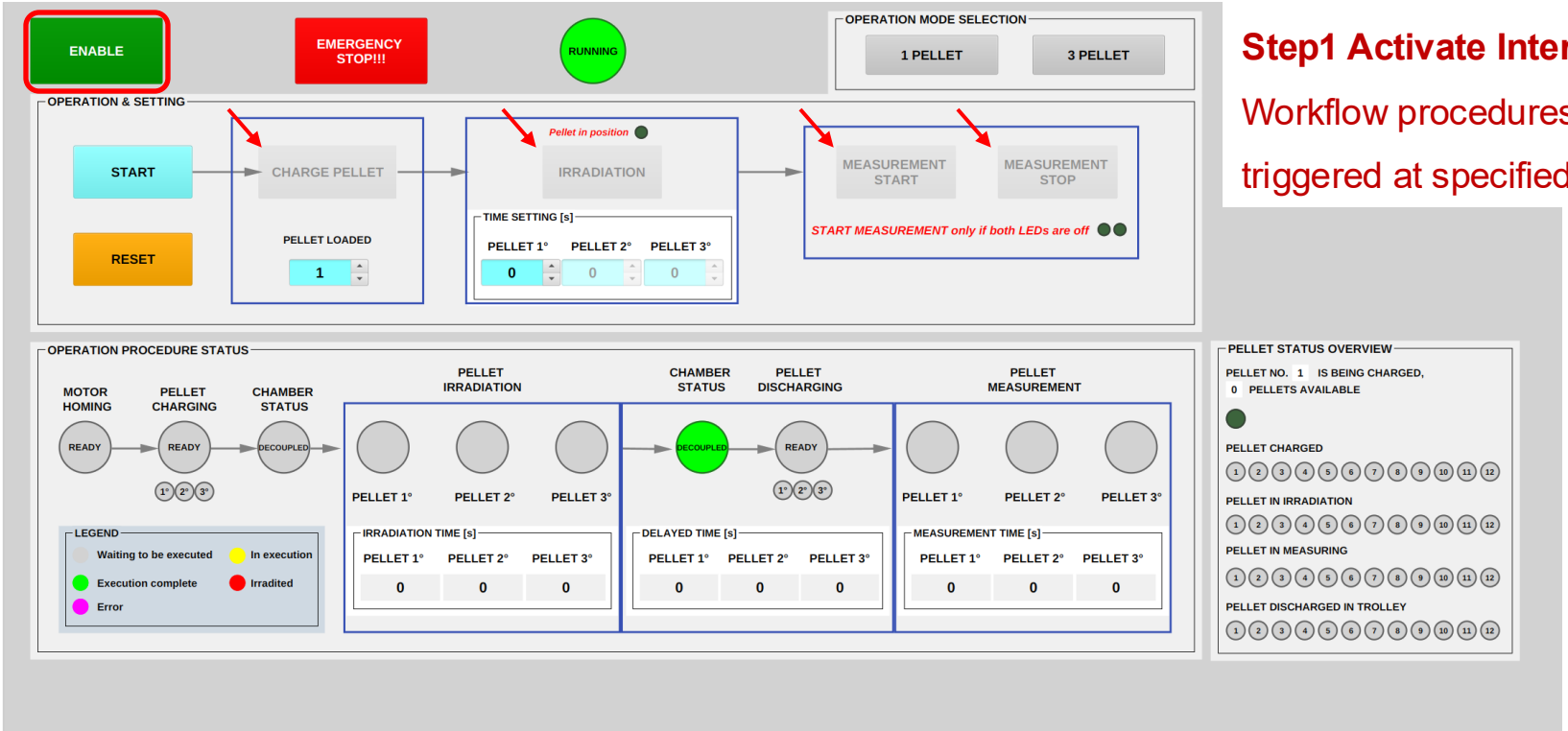
Level 1 – Full automation



For daily operation

- Mode selection
- Workflow control
- Status supervision

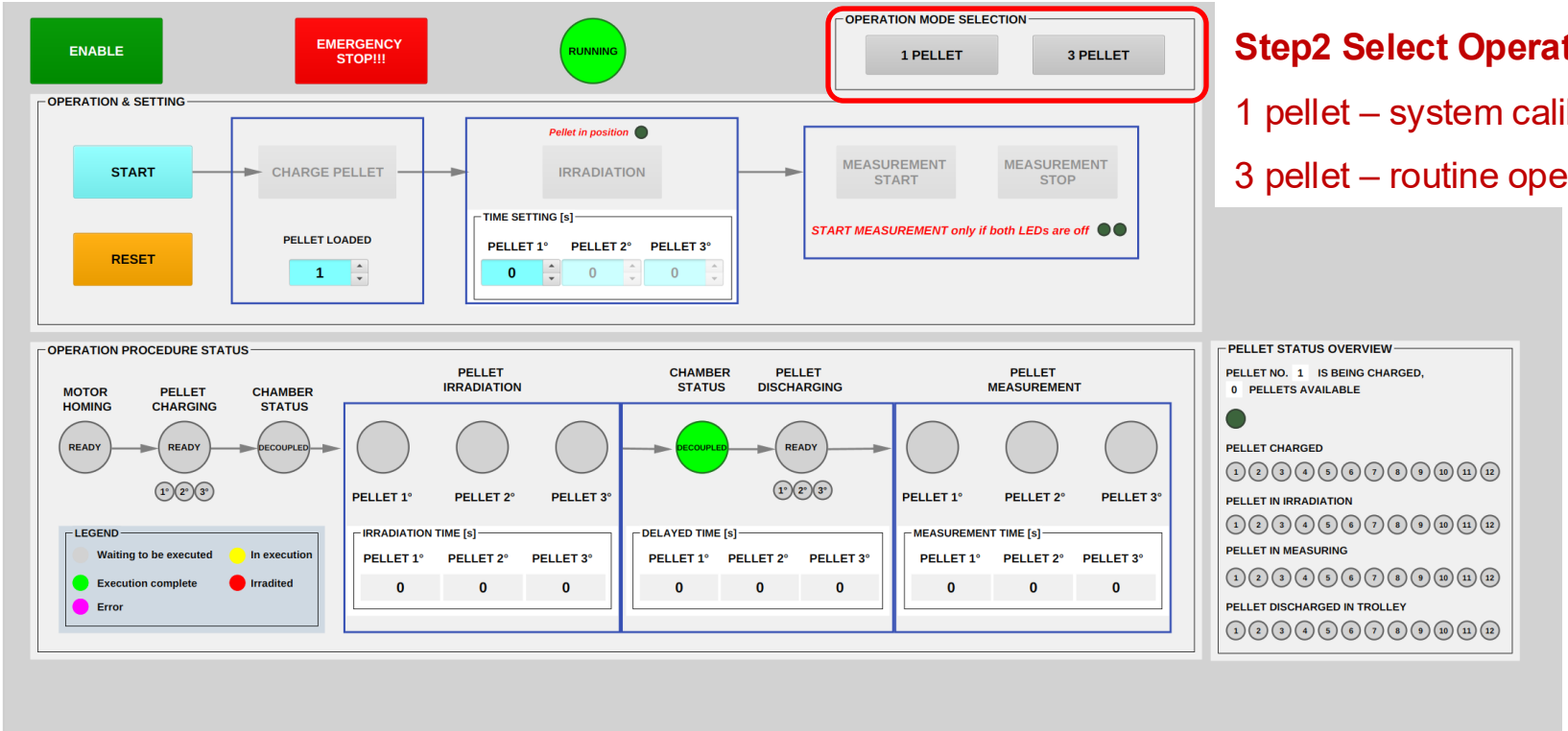
Motion control - Automatic - Base



Step1 Activate Interface

Workflow procedures deactivated, triggered at specified conditions

Motion control - Automatic - Base

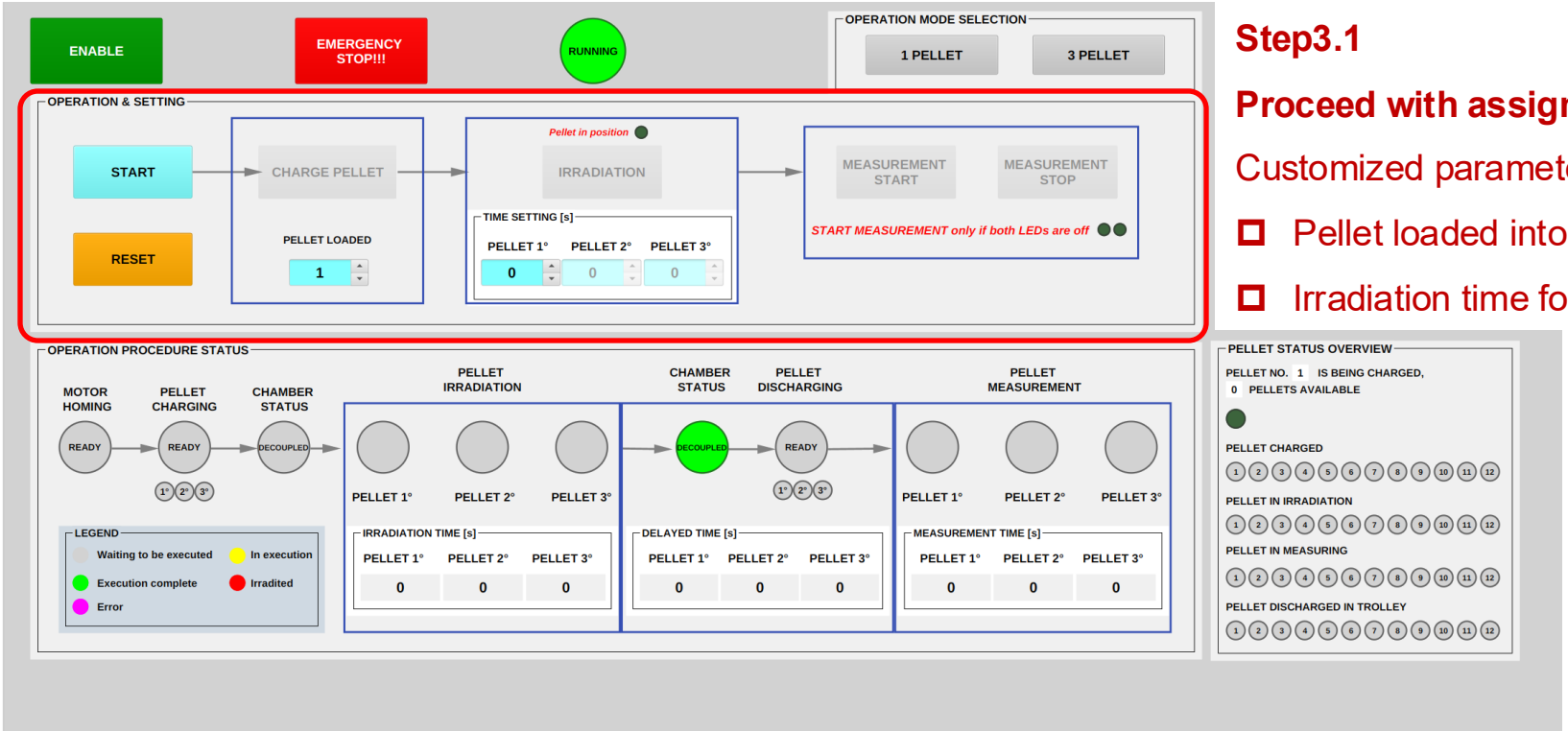


Step2 Select Operation Mode

1 pellet – system calibration tests

3 pellet – routine operation

Motion control - Automatic - Base



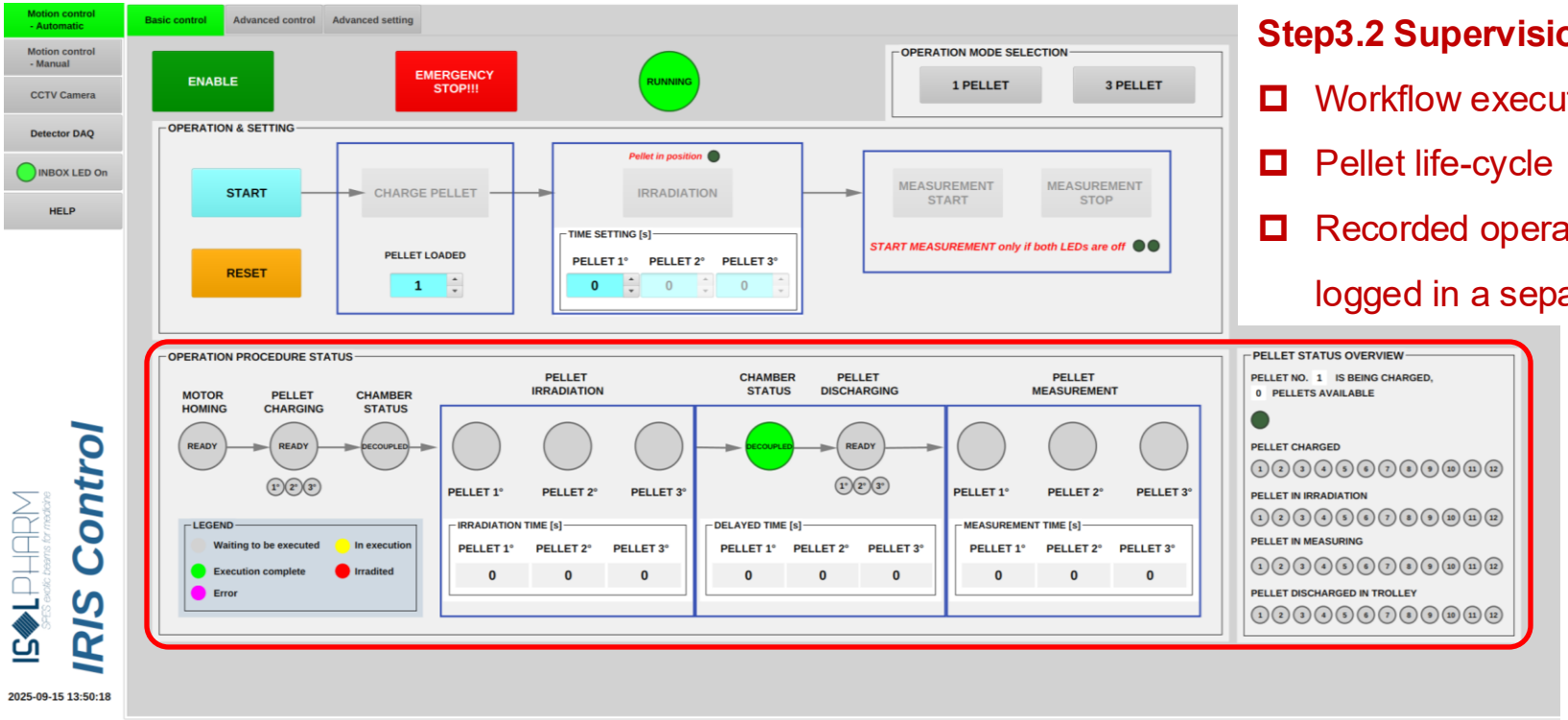
Step3.1

Proceed with assignments

Customized parameters:

- Pellet loaded into the system
- Irradiation time for each pellet

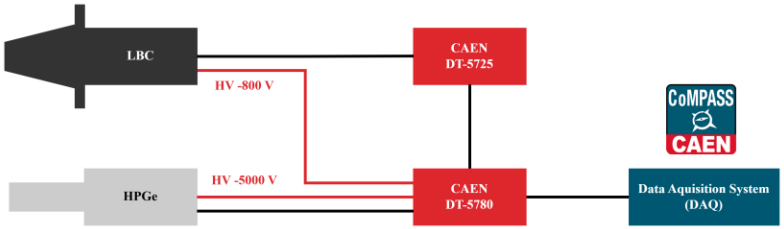
Motion control - Automatic - Base

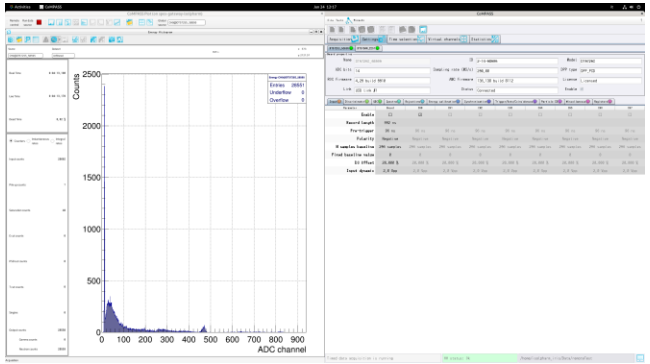


Step3.2 Supervision

- Workflow execution
- Pellet life-cycle
- Recorded operation time, logged in a separate file

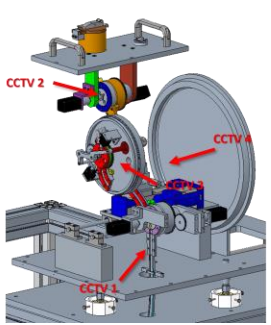
Detector DAQ & CCTV Camera

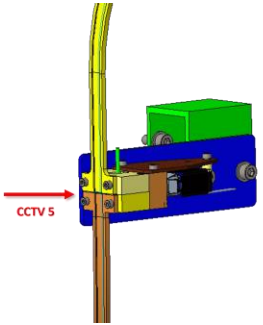




CCTV Camera

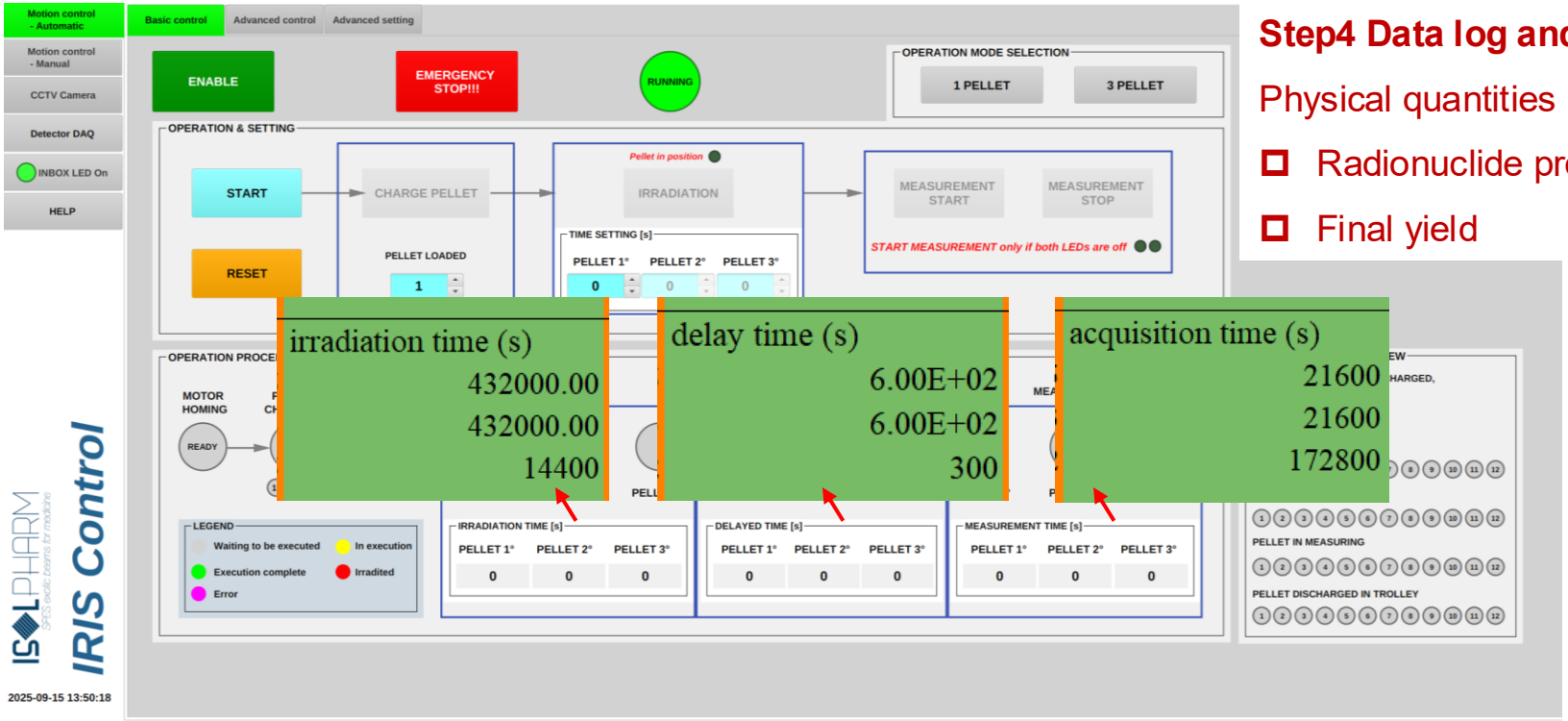
Detector DAQ





- Detection system DAQ and cameras are configured under local network with **separate systems**
- Integrated in the GUI as **“one-click” calling up** command, with executable scripts

Motion control - Automatic - Base



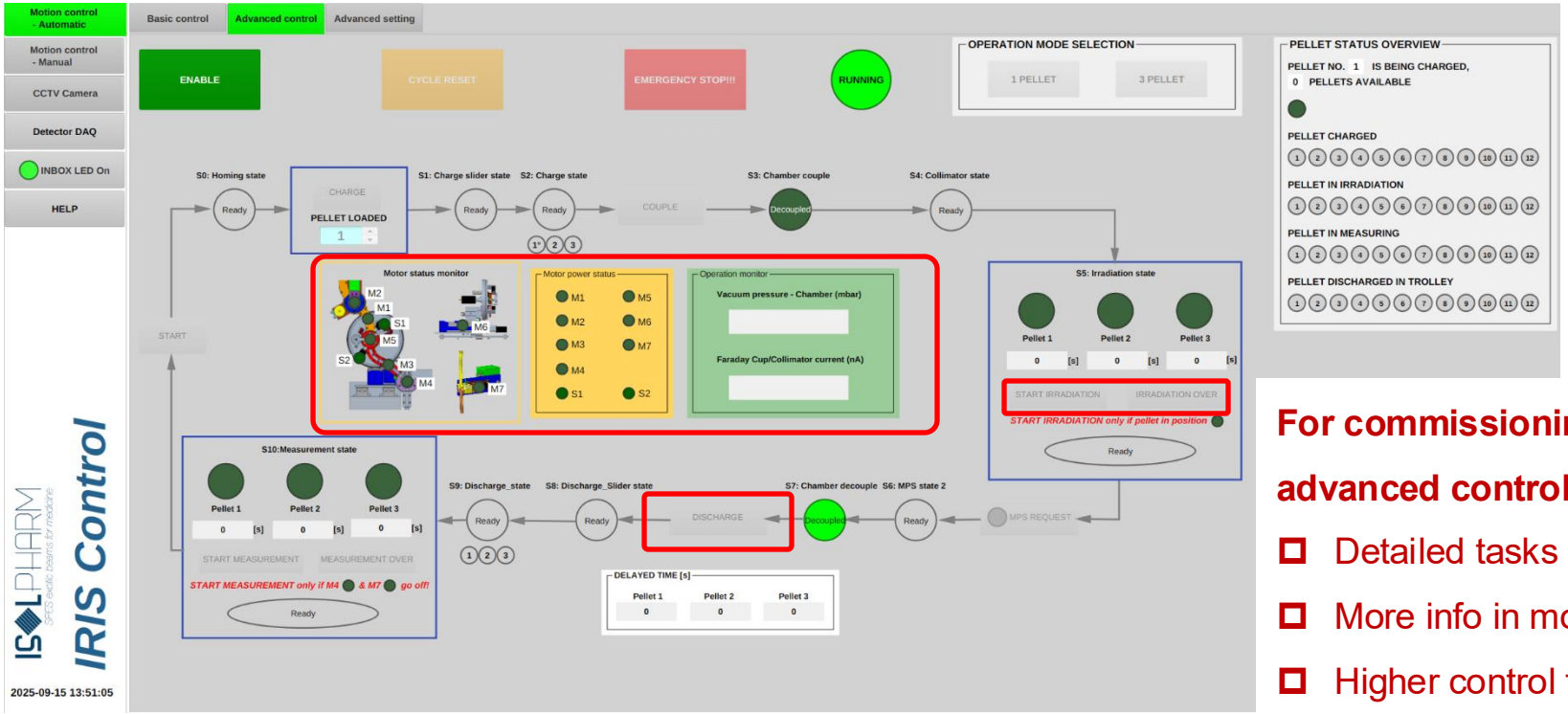
Step4 Data log and analysis

Physical quantities

- Radionuclide production
- Final yield

Motion control - Automatic - Advanced

Level 2 – Semi-automation



For commissioning & advanced control

- Detailed tasks breakdown
- More info in monitoring
- Higher control freedom

Motion control - Automatic – Advanced setting

You can even tune the exact motor axis steps here

Motion control - Manual

Level 3 - Manual

For commissioning,

fully customized movements

- Motor movements and presets
- Motor status monitoring
- Solenoid movements

Conclusion and prospect

- IRIS control system have been built and commissioned regarding operational capabilities
- Further commissioning is expected in the first implantation experiments
- Functionality and GUI could be upgraded from the perspective of third-party utilization, comments and suggestions are welcome